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FACTS

FOR ENVIRONMENTAL STUDIES



Ministry
of the
Environment

Ontario

about pollution...

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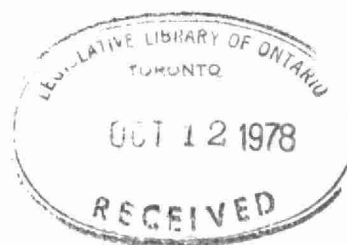
AIR POLLUTION INDEX

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SLIDE SHOW/SEMINAR



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FACTS

FOR ENVIRONMENTAL STUDIES



Ministry
of the
Environment

ONTARIO'S AIR POLLUTION INDEX: AN EDUCATIONAL FACT SHEET

APRIL, 1976

API

I Introduction

The Ministry of the Environment keeps a close watch on air pollution levels in major urban and industrial areas across the province. It is a fact that a certain amount of air pollution occurs naturally, but people in their living habits, working and travelling are the major contributors. In a complex, technologically-based society, there will always be some air pollution. The Ministry of the Environment has established acceptable levels for pollutants to maintain a safe and relatively pollution free environment.

INDEX LEVEL	EFFECTS	ACTION
0 - 32	Conditions considered acceptable for everyone's health.	No action necessary
32		ADVISORY LEVEL: If weather conditions likely to persist, major sources of pollution advised to prepare to reduce operations.
50		FIRST ALERT: Mandatory curtailment of major sources of pollution.
58	People with severe respiratory diseases may have some increase of symptoms.	
75		SECOND ALERT: Further shutdown of operations.
100	Mild effects on healthy people. Severe effects possible for cardiac or respiratory cases.	EPISODE THRESHOLD LEVEL: All sources of pollution not essential to public health or safety may be ordered to shut down.

An air pollution index has been designed for Ontario cities. This index is based on the concentrations of sulphur dioxide and suspended particulate matter in the air. The index is computed hourly and publicized four times daily. The index gives warning of air pollution build-up. As a build-up occurs, abatement measures are taken to reduce the higher index to a safe and acceptable level.

II The Alert

An air pollution index of less than 32 is considered acceptable. Below this level, the concentrations of sulphur dioxide and particulate matter are not considered hazardous to human health. But when the index reaches 32 or is approaching it, and weather conditions are expected to aid and abet air pollution for at least 6 hours, operators of significant sources of pollution in the community may be advised to prepare to curtail their operations.

When the air pollution index reaches 50 and meteorological forecasts indicate high pollution potential for an additional 6 hours, the "first alert" is issued. Owners of major sources of air pollution may be ordered to curtail operations. The index of 50 for the first alert was established on the basis of medical criteria. People with chronic respiratory diseases begin to experience problems and symptoms of respiratory illness when the air pollution index for sulphur dioxide and particulate matter reaches 58. The first alert at index 50 provides a reasonable margin of safety.

If the abatement action -- the curtailing of operations on the part of polluters -- does not lower the levels of the index, a "second alert" is issued when the index reaches 75. A further and sharper curtailment of operations for major sources of air pollution is then ordered.

When the air pollution index reaches 100 and meteorological forecasts indicate that high air pollution conditions will continue for an additional 6 hours, the "air pollution episode threshold level" is announced. All sources of pollution not essential to public health and safety are then ordered to cease operation.

The index level of 100 was chosen because it represents a serious hazard to people with severe cardiac and respiratory illnesses. The effects of this pollution level on healthy people is considered to be mild.

III The Effectiveness of the Index

The index was first introduced in 1970, in Toronto. It has since been extended to other Ontario communities (Hamilton, Sudbury, Windsor, Niagara Falls and Welland).

The Ministry's program for reducing air pollution makes it unlikely that we will experience readings as high as those that have occurred in the past. In fact, levels of sulphur dioxide and particulate matter, as reflected by the readings, have declined steadily in recent years.

It is noteworthy that the Ministry has generally received excellent co-operation from operators of pollution sources when index levels are near or approaching the 32 level. There is no doubt that the air pollution index is an effective way to monitor day-to-day air pollution levels, and to alert government, industry, and the public when air pollution reaches hazardous stages.

IV Facts on Sulphur Oxides

- 1) Sulphur dioxide is the most common pollutant containing sulphur. Sulphate and sulphite salts are also common. Hydrogen sulphide, which is quite odorous is present in local areas where petroleum is refined.
- 2) In 1967 the estimated global emissions of sulphur dioxide were 146×10^6 tons.
- 3) Over 50 monitors, each worth between 4 and 7 thousand dollars, monitor sulphur dioxide concentrations. Data from many of the monitors are telemetered to a central office in Toronto.
- 4) Sulphur oxides are formed primarily during the combustion of fuels (such as coal and oil) and different fuels vary in their sulphur content. Some industries can switch from one fuel to another during pollution episodes to reduce sulphur oxide formation.
- 5) When sulphur oxides combine with water in air they form toxic acid aerosols that corrode paint and metal surfaces, fabrics and plant leaves.
- 6) Chronic injury in plants occurs because of long-term absorption of sulphur dioxide at just below sub-lethal levels. The coloring of the leaf is the indicator of the level of sulphur dioxide in the plant's chronic stage. The leaf will take on a yellow tinge (chlorosis) or will even surface as a bronzing on the underside of the leaves.
- 7) Sulphur dioxide is colorless with a characteristic pungent suffocating odor.
- 8) Sulphur oxides are generally believed to aggravate existing respiratory diseases in humans and possibly through continued exposure cause mucus membrane irritation and mucus secretion.
- 9) Concentrations of sulphur oxides as small as 0.03 parts per million (ppm) of air, has been observed to cause injury to some plants. At a concentration of 0.12 ppm, sulphur oxides have increased the rate of corrosion of steel panels by 50 per cent.

V Facts on Suspended Particulate Matter

- 1) Particulate matter is a contaminant produced by nearly all combustion and industrial processes, heavy industry and incinerators being the major sources.
- 2) The wind and traffic disperse particulates continuously in the atmosphere of an urban city. Because of the soiling and visibility effects of particulates, the public at large more closely identifies this factor as pollution than any other air pollutant.
- 3) The term particulate matter pertains to solid and liquid particles which are small enough to remain suspended in the air. For the most part, only particles under 40 microns in diameter remain suspended and can be inhaled.
- 4) Normal filtration by the human respiratory system (hairs, air passages, mucus) removes most particles over 5 microns in diameter.

- 5) Particles less than 5 microns may either be retained or exhaled again. Those that are retained may be quite inactive, or may exert a local irritant effect, or may be dissolved and absorbed into the blood stream.
- 6) Particulates are perhaps most dangerous in conjunction with other air pollutants. Many people believe that various particulates when inhaled deep into the lung may carry with them poisonous substances including sulphur dioxide, hydrocarbons, and nitrogen dioxide.
- 7) On a normal day in a city such as Toronto, a city dweller could breathe up to a pound and a half of dust particles.
- 8) Some of the major cities in Ontario such as Toronto, Windsor and Hamilton have dustfall rates in excess of 20 tons of dust per square mile per 30 days period.
- 9) With every breath we take, the average person inhales between 40 and 70 thousand solid particles into their lungs.
- 10) In heavy coal-burning areas of the world, dustfall levels up to 100 tons per square mile per 30 days have been recorded.
- 11) Very small aerosols (from 0.001 to 0.1 micron in diameter) can act as nuclei on which vapor condenses relatively easily. Fogs, ground mists, and rain may be thus increased and prolonged.

VI Some Questions for Consideration

- 1) Some of the words used in this fact sheet may be new to you. What do the following words mean?

a) telemetry	e) monitor
b) criterion	f) chronic
c) emission	g) abatement
d) ambient	h) aerosol
- 2) You should be able to devise in your own words definitions or descriptions of each of the following:
 - a) Air Pollution Index
 - b) "second alert"
 - c) sulphur oxide
 - d) particulate matter
- 3) If you wish to add to your air pollution vocabulary, obtain descriptions for the following words and explain how they are part of the air pollution problem:
 - a) hydrocarbons
 - b) ozone
 - c) carbon monoxide
 - d) greenhouse effect
 - e) nitrogen dioxide
 - f) lead
 - g) asbestos
- 4) It is said that air pollutants "abrade, corrode, tarnish, soil, crack, weaken and discolor" many varieties of materials. Give examples, if you can, of things that are affected in each of the above ways, and if possible tell what air pollutant is the causative agent.

- 5) It has been stated that the major variables affecting the nature and seriousness of the air pollution problem at any one time in a given place are:

- | | |
|------------------------------|----------------------------------|
| a) types of pollutants; | g) decrease or increase of air |
| b) quantity of pollutants; | and temperature with height; |
| c) wind speed and direction; | h) susceptibility of individuals |
| d) topography; | to particular pollutants or |
| e) sunlight; | combinations of pollutants. |
| f) precipitation | |

Obtain a road map of the area in which you live. Pin-point your location and then locate another town or city that you have first-hand knowledge about, some 50 to 200 miles away. Draw a straight line between the two locations. For each of the above variables describe as best you can the similarities or differences between the two cities. In a concluding sentence, which area is better off as far as air quality is concerned?

VII Some Data

In Ontario, in 1971, the criteria for desirable ambient air quality stated that sulphur dioxide levels should not exceed 0.25 ppm averaged over a one hour period, and 0.10 ppm over a 24 hour period. Which cities exceeded the criteria at sometime in the monitoring period? If you have knowledge about the cities listed, give reasons why the criteria were exceeded in some of the examples listed.

VIII Research Topics

Each of the following could be used as a title for a lengthy research topic:

- 1) photochemical smog
- 2) meteorological aspects of pollution
- 3) air pollution disasters - a history
- 4) disease associated with air pollution
- 5) the origin of air pollutants
- 6) the chemical nature of air pollutants
- 7) the economics of air pollutants
- 8) public opinion on air pollution
- 9) air pollution and plants
- 10) industrial control measures of air pollution
- 11) local air polluters
- 12) the legislation on air pollution

References

1. Pollution: An Ecological Approach by Robert G. Adamson, Bellhaven House Ltd., Toronto, 1971.
2. A Citizen's Guide to Air Pollution by David Bates, McGill-Queen's University Press, Montreal, 1972.
3. Air Pollution, Teacher's Edition by Lavaroni and O'Donnell, Addison-Wesley Publishing Co., Toronto, 1971.
4. Air Pollution Primer, American Lung Association, 1969.

LOCATION	NO. OF MONTHS	ARITH-METIC MEAN	MAXIMUM 1-HR.	24-HR.
471 University Ave., Windsor	12	.042	.60	.20
Morton Dock, Windsor	12	.015	.33	.14
Met. Tower, Courtright	12	.021	.83	.13
Victoria St., Sarnia	12	.026	.59	.14
King-Rectory, London	9	.015	.09	.05
Hort. Station, Simcoe	10	.012	.11	.07
Deamude, Port Maitland	9	.019	.39	.05
Reeve's House, Port Maitland	12	.024	.58	.15
P.U. Sub-Station, Waterloo	7	.016	.08	.04
North Park, Hamilton	8	.013	.12	.07
Barton-Wentworth, Hamilton	12	.029	.31	.16
Woodward-Brampton, Hamilton	6	.028	.19	.08
67 College St., 5th Fl., Toronto	12	.052	.54	.25
Univ. of Toronto, Toronto	10	.040	.35	.10
City Hall, Toronto	9	.041	.60	.19
1 Leslie St., Toronto	12	.042	1.01	.22
67 College St., 1st. Fl., Toronto	11	.038	.54	.18

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FOR ENVIRONMENTAL STUDIES



Ministry
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RESOURCE

The Province of Ontario has undergone an expansion of population, of rapid urban growth and of the production and consumption of goods and energy without parallel. This has contributed greatly to the prosperity and well-being of the people of this province. Unfortunately, in this and other advanced industrial nations, these very successes have generated new problems.

One of the most critical problems facing us today is how to deal with the huge and growing volume of waste produced by our affluent, throw-away society. On a broader scale, the urgent need for conservation of diminishing world resources has been dramatically emphasized by recent events.

A number of separate waste management programs have been developed in the short time since the province assumed responsibility in this field via The Waste Management Act of 1970.

These approaches have been integrated into a single comprehensive provincial program, which uses every means available to recover all of the valuable resources from the waste produced, and at the same time to eliminate unnecessary waste.

The provincial plan is designed to provide in three five-year stages all the facilities necessary for complete resource recovery, to serve at least 90 per cent of the population of the province, and all but eliminate the need for the landfill of waste.

This can only be achieved by a major government effort but it will also require the co-operation of municipalities, industry and the public.

The difficulties must not be underestimated. Although the development of technology has been proceeding very rapidly indeed over the past few years, it has not yet been proven for practical use. Pilot plants built to demonstrate the operation of particular proprietary processes or equipment are of very limited value.

Moreover, the development of new markets and new uses for the material separated from waste must proceed at the same pace as technological development if resource recovery from waste is to be of real rather than merely token benefit.

The comprehensive provincial program is designed to provide both short and long-term solutions to these problems, not just for metropolitan areas, but for municipalities of all sizes.

RECOVERY

Related Programs

Waste management planning studies, apart from providing essential basic data on the quantities and types of waste produced, lead to the development of improved waste management systems. Generally, this will involve the replacement of landfill disposal sites by transfer stations and the use of efficient, long-haul transportation to carry the waste to a comparatively few central facilities.

The Ontario reclamation research centre, incorporating a full scale experimental reclamation plant, is being built to find and prove the technology for complete resource recovery. It will also provide a regular supply of separated material, of controlled quality, which is necessary for the development of markets and new uses for the separated waste material, and in addition will provide a training-ground for operators of future plants.

Technology

A complete resource recovery plant can be considered in two sections, generally called front end and back end processes. The technology for front end processing is relatively well developed. This includes shredding the waste to a uniform size, magnetic separation of tin cans and other ferrous metals, and air classification processes to separate the remaining waste into two streams, a light fraction composed principally of paper fibre and plastic film, and a heavy fraction composed principally of non-ferrous metals, glass, organic material, plastics, and the miscellany of other materials which may be found in waste.

The back end processes include a very large number of possible different options, directed at the separation of all these materials in different forms, depending upon the market to which they will be directed. The technology for these back end processes is relatively undeveloped and unproven.

It is important to note that the front end processes have many advantages in themselves, even if the material produced is subsequently landfilled, or incinerated for the production of energy, as an interim measure. Nuisance effects are almost eliminated, cost is reduced, and a proportion of marketable materials can be recovered immediately.

The provincial program is based on this approach, which provides substantial benefits now, and is sufficiently flexible so that immediate advantage can be taken of new processes and equipment as they are developed and proven at the reclamation research centre.

Program Stages

Stage 1

During stage 1, between 1975 and 1980, waste management systems throughout the province will be improved by the replacement of disposal sites by transfer stations, so that disposal operations in a particular area are concentrated in a few large sophisticated facilities.

At the central facilities serving major population centres front end processing plants will be installed. At those plants, a proportion of readily separable and marketable material such as corrugated paper, bundled newsprint, and ferrous metals will be removed for sale, and the remainder shredded.

Air classification equipment will be installed at locations where a use exists, or can be developed, for the light or heavy streams which will be produced.

During this period, Environment Ontario may also support certain large-scale demonstration projects as an interim measure providing that they are compatible with the objectives of the provincial program, and are sufficiently flexible to be incorporated within the program eventually. Generally, these will be experimental projects which can only be proven in actual practice. The Watts from Waste project, which is essentially a front end plant using the separated light fraction as a fuel in existing boilers, at Lakeview Generating Station is a typical example of such a project.

Stage 2

During stage 2, between 1980 and 1985, the provision of transfer stations and transportation networks should be completed throughout the province, which will enable the remainder of the front end plants needed to be constructed.

The full development of this concept is, however, contingent upon the improvement of long-haul transportation of waste, by the use of rail-haul for example.

During this stage, also, sufficient progress should have been made in process technology and market development to enable work to begin on the installation of proven back end recovery processes.

Stage 3

Finally, in the third stage between 1985 and 1990, it will be possible to complete the program by the installation of complete resource recovery processes, serving 90 per cent of the population of the province, and all but eliminating the need for the landfill of municipal waste.

Front end Processing Plants

Ontario is negotiating with municipalities to construct front end processing plants. The entire capital cost will be provided by the Government of Ontario, fifty per cent being recoverable over a forty-year period, as an addition to the user charge per ton of waste processed at the plants.

The plants will vary in design capacity from 200 to 1,000 tons per day, and the total capital cost will amount to 17 million dollars.

Since some of the plants, even initially, will serve more than one municipality, the province, through the Ministry of the Environment, will retain ownership to ensure that their design and operation are compatible with the comprehensive provincial program, and to co-ordinate and develop markets for reclaimed materials.

Ministry staff is also meeting with the private waste management companies and the recycling industry to discuss their role in the provincial program. They will have a very significant role, both in the first stages of the program and increasingly in the future.

The provision of front-end plants alone does not pretend to be a complete solution to municipal waste management problems. However, it is a necessary first step, and a very substantial step towards the complete solution which is the goal of the comprehensive provincial program. A proportion of the waste will be reclaimed for reuse immediately, and this and the processing of the remainder, will reduce landfill requirements, the cost of transportation and landfill, and very substantially reduce disposal problems, even during the comparatively short time until further processing equipment for greater resource recovery can be introduced.

Waste Management Advisory Board

A major program objective is to reduce the quantity of waste produced. Apart from this, it is unlikely that the other objectives can be fully achieved unless action is taken to minimize the misuse of materials which results in unnecessary waste or which may make it more difficult to recover these materials, and to investigate in depth all of the non-technical constraints which may operate to inhibit the economic use of recovered materials.

A Waste Management Advisory Board has been set up to investigate and advise on these particular problems.

The extent and significance of the work which the board is being asked to do cannot be over-emphasized. It is essential that it be carried out in parallel with investigation into process technology at the resource recovery centre, and that very close liaison be maintained between the board, and the staff of the Ministry of the Environment responsible for the implementation of the comprehensive resource recovery program.

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ODOURS

Odour is an old problem. It has been around as long as there have been noses. In 1661, coal smoke was so bad in London that the diarist John Evelyn, in writing about it stated, ".....the weary Traveller, at many miles distance, sooner, smells, than sees the City."

Odour is a nuisance factor connected with air pollution. While not a health hazard itself odour does lessen the enjoyment of the natural environment, especially during the summer months. High daytime temperatures, little or no air movement and increased outdoor activity alert more people to odours.

The Ministry of the Environment and its predecessors in the Ontario Government have been pursuing odour problems since 1968 with the result that in the Metropolitan Toronto area, the number of odour complaints received has been reduced by one-half in the past two years.

Millions of dollars have been spent in this area by industry, apartment owners, institutions and individuals to control odorous emissions, largely as a result of Environment Ontario's air pollution abatement programs. In addition to working on existing problems, Ministry staff assess the odour potential of new sources and require appropriate controls to prevent new problems.

Odours account for 40 per cent of the air pollution complaints in Metropolitan Toronto. The major sources of odour complaints are apartment incinerators, rendering and slaughtering plants, chemical plants, sewage treatment plants, paint baking and curing operations and metallurgical operations.

Each odour complaint is thoroughly investigated by Ministry field staff and appropriate abatement action is taken.

Apartment Incinerators

Obnoxious odours from apartment incinerators usually result from burning of garbage at less than optimum temperature. Flue fed type incinerators, in particular, are poorly designed for efficient burning and distill odorous chemical compounds from domestic wastes. Fly ash, mostly from the burning of newspapers and food packages, is emitted in varying degrees by all apartment incinerators.

No practical method of controlling odorous emissions from flue fed incinerators has been found and this type of incinerator is gradually being eliminated.

Fly ash emissions from incinerators are reduced to a large degree by screens mounted on chimneys.

Rendering Plants

The offensiveness and quantity of odours from rendering plants is influenced by a variety of factors ranging from the age and condition of the raw materials, to poor housekeeping. The most commonly applied control devices for this industry are condensers and/or afterburners, and wet chemical scrubbers.

Slaughtering Plants

Odours emitted from slaughtering operations can be differentiated into two categories: those resulting from holding of the livestock in the yards prior to slaughtering; and those released from the exposure of blood, other animal matter and paunch manure during the killing operation.

Chemical Plants

Odorous compounds are products of many chemical operations. In general, they are formed when nitrogen or sulphur compounds are associated with organic materials at high temperatures. Abatement depends entirely on the nature of the chemical process and the odourant. Each group requires specific controls.

Sewage Treatment Plants

At sewage treatment plants, malodorous gases are produced biologically through the breakdown of proteinaceous materials and by reduction of sulphates. Problems usually occur because of plant overloading, electrical failures, sludge handling or disposal, or improper plant operation. A current method of control of odours is enclosure and venting of the gases to a chemical scrubber.

Paint Baking Operations

Odours result from the partial breakdown of hydrocarbon solvents in the paint ovens. Common solvents in use are lacquer thinners, toluene, methyl ethyl ketone and other petroleum distillates.

Odours from these sources may be abated by the use of water-based paints as well as high exhaust stacks to improve dispersion and reduce ground level concentrations.

Metallurgical Operations

In foundries, pig iron and scrap metal are melted in a cupola or electric furnaces and then cast in sand moulds to produce gray iron castings. Malodorants are emitted primarily from the partial combustion and distillation of organic material on oily scrap charged to the furnace.

Secondary metal separation involves the recovery of metals from scrap material in reverberatory furnaces. The odorous emissions result from the incomplete combustion on grease, rubber, plastics, paint and other organic material contained in the scrap. Afterburners are used effectively to control the release of these contaminants.

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FOR ENVIRONMENTAL STUDIES

NOISE MEASUREMENT - THE DECIBEL: AN EDUCATIONAL FACT SHEET

NOISE

Sound or noise is produced by vibrations from machines, hi-fi speakers, or from aero-dynamic sources such as gas exhausts, etc. It is transmitted through the air because these vibrations set the air molecules in motion causing them to pulsate to and fro very slightly. This results in slight variations in the atmospheric pressure. We hear these pressure variations as sound, because our ears are sensitive to these minute pressure changes. Microphones which are used on instruments to measure sound or noise levels are also sensitive to these small changes in pressure. The intensity of a sound is proportional to how much it causes the atmospheric pressure to change, and the rate at which the pressure alternately increases and decreases determines the frequency or pitch of the sound.

The measurement volume or magnitude of sound is achieved by detecting these changes in the atmospheric pressure, and the "yardstick" used to indicate these Sound Pressure Levels is called the decibel or dB. The pitch or frequency is measured by the number of vibrations (or pressure fluctuations) per second and expressed by a unit called Hertz.

Although the changes in the atmospheric pressure caused by sound or noise are always small, the loudest sounds we hear produce a pressure change about 10 million times greater than those which result from the faintest sounds we can hear. Because of this large spread, a simple linear measurement scale for noise would have to run from 0 to 10,000,000 and as a result, its use would be rather awkward. Consequently, a more functional "compressed" scale is used to denote sound intensities in decibels. Mathematically speaking, it is called a logarithmic scale and it allows us to count in bigger and bigger steps like 1, 10, 1,000, etc. rather than 1, 2, 3, etc.

Sound Pressure Pa (Pascal units)	Sound/Level dBA	Typical Noise Sources
0.0002	0	Threshold of hearing
0.002	20	Soft Whisper
0.02	40	Quiet Residential Area
0.063	50	Urban Residential Area
0.20	60	Typical Conversation
0.63	70	Passing Car
1.0	74	Accelerating Car
2.0	80	Lawn Mower
6.3	90	Passing Truck
20	100	Snowmobile
200	120	Rock Band
630	130	Jet take-off

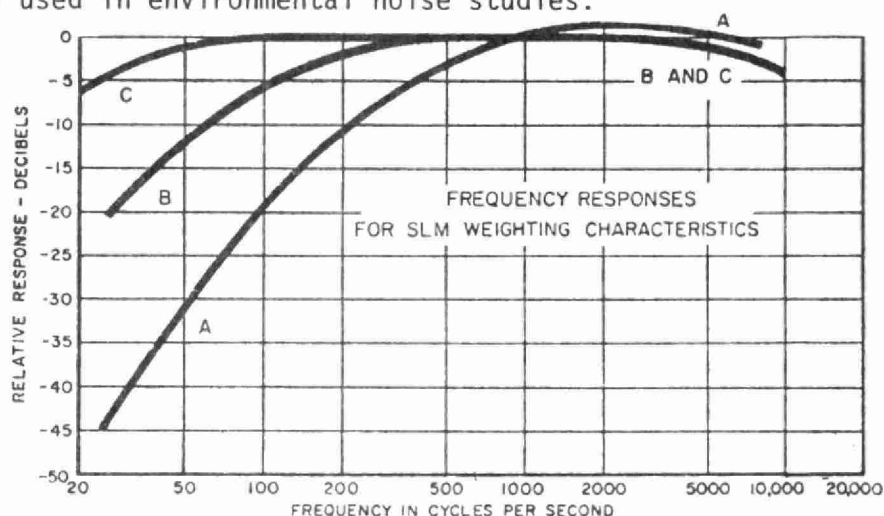
The table above illustrates the change in atmospheric pressure given in Column 1 and the corresponding decibel levels indicated by the Sound Level in Column 2. A few typical sound sources which produce these levels are also listed.

Because of the complex relationship between the pressure of a sound and the decibel scale, decibel levels from various sound sources cannot be directly added, subtracted, or multiplied. In this case, one has to add or multiply the pressure changes caused by the sound source and compute the decibel levels. Note from the table above that doubling the sound pressure from 1.0 to 2.0 Pa (which corresponds to doubling the intensity of the sound) only results in an increase of the dB level from 74 dB to 80 dB or 6 dB. On the other hand subjectively a sound of 80 dB is about twice as loud as a sound of 70 dB, and a sound level of 90 dB is twice as loud as one of 80 dB or four times as loud as one at 70 dB. This also applies to decreasing sound levels.

It is of interest to note that while the ear is very sensitive to sound, it cannot easily discriminate between different sound levels. If a noise reduction or increase from a source is to be noticed by people, the change must be about at least 2 dB which corresponds to about a 40% change in the intensity of the sound.

Confusion often arises about determining the overall noise levels from multiple sources. For example, if two identical machines each producing a noise level of 90 dB are run side by side, their combined noise is not 180 dB but 93 dB. Again, one must consider the combined effect of adding pressure changes rather than decibel levels. If a third machine is added, the combined noise of the three would be about 95 dB. This number results by adding the pressure changes due to the three sources and computing the corresponding decibel reading. When a device (such as a snowmobile) has several sources of noise all of which are produced by about the same intensity and frequency, the noise from each of these sources must be reduced if the overall noise level is to be significantly lowered.

Sound levels are often given in units of dBA where the "A" has a special significance related to the frequency of the sound. We hear sounds at some frequencies better than others. For example, the ear cannot sense a sound below about 20 hertz (i.e. 20 vibrations per second) and over about 20,000 hertz. It is most sensitive in the frequency range of about 2,000 hertz (about top C on the piano). The sensitivity of the ear also decreases gradually from about 50 Hz (hertz) downward. The sound level meter can also be made to have varying sensitivity to sound at different frequencies. When the Sound Level Meter is switched to the "A" scale, it will register the frequency spectrum similar to the way that the ear hears it, and as a result, is commonly used in environmental noise studies.



This graph shows the frequency response of the sound level meter over the audible sound spectrum. The "C" scale (or weighting) represents an almost uniform measurement response; the "A" scale represents the response of the human ear around 40-50 dB sound levels and the "B" scale (which is relatively little used) represents the response of the human ear around 80-90 dB sound levels.

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FOR ENVIRONMENTAL STUDIES



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PLANNING A POLLUTION SLIDE SHOW/SEMINAR AN EDUCATIONAL FACT SHEET

(This fact sheet was prepared to assist teachers interested in student project work in the area of environmental studies).

I Introduction

Students can plan, prepare and present a slide show on local pollution problems. A school seminar session or series might act as a springboard to initiate further activities on a larger scale. A seminar program, if successful, could bring an awareness of local conditions to a larger segment of the student body.



II Possible Slide Show Topics

1. Pollution: IN and AROUND the School
2. A Trip Down ----- Street in Search of Pollution
3. A Pollution Study of ----- Park
4. Litter: Type, Distribution and Quantity Around the School
5. Litter in the Neighborhood of the School
6. Litter in a Local Commercial Area
7. A Litter Comparison: ----- School vs. ----- School
8. All the Sources of Waste in the School
9. Before and After Pictures: Litter Clean-ups
10. Noise Sources in the School

III Procedural Points

1. The photography can be accomplished in a number of ways. Photos might be obtained during a class field trip as just one of many activities of the day. On the other hand, students may be organized to take the pictures on their own time or even in class time.
2. The students should not only concentrate on the impact they wish to create on the audience, but should also strive to present an honest account of the situation.
3. A date should be established for the presentation of the slide program (such as in a seminar or at an assembly) so that the students involved may have a goal and a deadline to work towards.
4. The level of sophistication of a slide presentation will vary according to the capabilities of the students involved, but it should be noted that the co-ordination of both sound and slides will enhance the production considerably. Thought should be given to taking a tape recorder into the field at the time the photographs are obtained.

IV Things to Consider Before Getting Involved

- a. Is the student body aware of local pollution problems?
- b. Is it worth making them more aware?
- c. Does telling a person about pollution have as great an impact as showing them?
- d. Can a slide show, illustrating pollution, be made interesting enough to students to change their attitudes or thoughtlessness?
- e. What should be the time duration of an individual slide show and what are the costs involved in production?
- f. What pictures could really have an impact on other students in the school?
- g. Should there be a sound-track to accompany the slides?

V A Suggested Reference

Producing Slides and Filmstrips available from the Eastman Kodak Company, 1970. Approximate cost \$1.75.

(This fact sheet is adapted from an activity outlined in the publication A Curriculum Activities Guide to Water Pollution and Environmental Studies produced by the Institute of Environmental Education, 8911 Euclid Avenue, Cleveland, Ohio).